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by  
Article 19*

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## **AMENDMENT**

(Amended Claims under PCT Article 19)

Replacement Sheets for the Claims

International Application No.: PCT/JP03/07525

Applicants: Hidekazu Tanaka

Title: CRYOGENIC REFRIGERATOR

Rader, Fishman & Grauer PLLC

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CLAIMS

1. A refrigerator unit characterized by comprising:

means, which is provided between a power source and a

5 motor for driving an intake/exhaust valve managing an  
intake/exhaust cycle time of a refrigerator unit, for varying  
a frequency of the motor for driving the intake/exhaust valve;

a temperature sensor for detecting a temperature of a  
thermal load unit of the refrigerator unit; and

10 a controller for controlling the means for varying the  
frequency of the motor for driving the intake/exhaust valve in  
accordance with an output signal of the temperature sensor.

2. A cryopump characterized by comprising the  
refrigerator unit according to claim 1.

15 3. A cryogenic refrigerator characterized by using a  
compressor unit comprising:

means, which is provided between a power source and a  
compressor main body motor of the compressor unit, for varying  
a frequency of the compressor main body motor;

20 a high pressure sensor attached to a high pressure  
refrigerant pipe connecting an outlet of the compressor main  
body with a refrigerant supply port of the refrigerator unit;

a low pressure sensor attached to a low pressure  
refrigerant pipe connecting an inlet of the compressor main  
25 body with a refrigerant discharge outlet of the refrigerator

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unit;

a controller for controlling the means for varying the frequency of the compressor main body motor in accordance with output signals of the high pressure sensor and the low

5 pressure sensor, and

characterized in that a plurality of the refrigerator units according to claim 1 and one or more of the compressor units constitute the cryogenic refrigerator.

4. A cryogenic refrigerator characterized by using a  
10 compressor unit comprising:

means, which is provided between a power source and a compressor main body motor of the compressor unit, for varying a frequency of the compressor main body motor;

a differential pressure sensor provided between a high  
15 pressure refrigerant pipe connecting an outlet of the compressor main body with a refrigerant supply port of the refrigerator unit and a low pressure refrigerant pipe connecting an inlet of the compressor main body with a refrigerant discharge outlet of the refrigerator unit;

20 a controller for controlling the means for varying the frequency of the compressor main body motor in accordance with an output signal of the differential pressure sensor, and

characterized in that a plurality of the refrigerator units according to claim 1 and one or more of the compressor  
25 units constitute the cryogenic refrigerator.

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5. A cryopump characterized by comprising the cryogenic refrigerator according to claim 2 or 3.

6. The cryopump according to claim 5, comprising:

a temperature sensor for detecting a temperature at any

5 optional position of a cryopanel of the cryopump; and

a controller for controlling the means for varying the frequency of the motor driving the intake/exhaust valve managing the intake/exhaust cycle time of the refrigerator unit in accordance with an output of the temperature sensor.

10 7. A superconductive magnet characterized by comprising the refrigerator unit according to claim 1.

8. A super conductive magnet characterized by comprising the cryogenic refrigerator according to claim 2 or 3.

15 9. The superconductive magnet according to claim 7 or 8, comprising:

a temperature sensor for detecting a temperature of any optional position of the superconductive magnet; and

a controller for controlling the means for varying the frequency of the motor driving the intake/exhaust valve  
20 managing the intake/exhaust cycle time of the refrigerator unit in accordance with an output of the temperature sensor.

10. A cryogenic measuring apparatus characterized by comprising the refrigerator unit according to claim 1.

11. A cryogenic measuring apparatus characterized by  
25 comprising the cryogenic refrigerator according to claim 2 or

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3.

12. The cryogenic measuring apparatus according to claim  
10 or 11, characterized by comprising

a temperature sensor for detecting a temperature of any  
5 optional position of the cryogenic measuring apparatus; and  
a controller for controlling the means for varying the  
frequency of the motor driving the intake/exhaust valve  
managing the intake/exhaust cycle time of the refrigerator  
unit in accordance with an output of the temperature sensor.

10 13. A simple liquefaction apparatus characterized by  
comprising the refrigerator unit according to claim 1.

14. A simple liquefaction apparatus characterized by  
comprising the cryogenic refrigerator according to claim 2 or  
3.

15 15. The simple liquefaction apparatus according to claim  
13 or 14, comprising:

a temperature sensor for detecting a temperature of any  
optional position of the simple liquefaction apparatus; and

a controller for controlling the means for varying the  
20 frequency of the motor driving the intake/exhaust valve  
managing the intake/exhaust cycle time of the refrigerator  
unit in accordance with an output of the temperature sensor

16. The simple liquefaction apparatus according to claim  
13 or 14, comprising:

25 liquid-level detecting means within a liquid storage

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container of the simple liquefaction apparatus; and

a controller for controlling means for varying a  
frequency of a motor driving an intake/exhaust valve managing  
a intake/exhaust cycle time of a refrigerator unit in

5 accordance with an output of the liquid-level detecting means.

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# ABSTRACT

An inverter 22 is provided between a power source 20 and a motor 14 for driving an intake/exhaust valve managing the intake/exhaust cycle time of a refrigerator unit 10, while the output frequency of the inverter 22 is controlled in accordance with an output of a temperature sensor 24 which detects the temperature of the thermal-load unit (11) of the refrigerator unit 10. In this way, it is possible to adjust the temperatures of the respective refrigerators with a method having a high reliability, without using an electric heater.